Transcription, Translation, & Protein Building

We often think of DNA as the genetic carrier of information, however it plays bigger role in your daily life; regulating cellular metabolic activities, or making proteins. This laboratory will take you through the processes of transcription and translation, and the resulting protein structure that is the end product of these activities.

Proteins are built from individual amino acids whose sequence is dependent upon the DNA. As with all of biology, shape is everything. Each amino acid has one or more functional groups associated with the molecule. It is the bonding of these functional groups that change the amino acid sequence from a two dimensional linear shape to a specialized, highly contorted 3-D functional molecule. Only when the proper shape is attained will the protein begin to function.

You will work in groups of two. Student A will play the role of the mRNA, getting the DNA sequence from the front of the room (the nucleus) and transcribing that into mRNA. Student B will need to translate the mRNA into tRNA. Around the perimeter of the room are the **tRNA anticodons**. After matching your mRNA codon with the correct anticodon sequence, lift the card to determine the amino acid associated with that anticodon. Continue for the length of your DNA sequence. When finished, respond to the following statements.

1. What is your DNA Gene number?

2. Write down your DNA sequence.

3. Write down your **transcribed** mRNA sequence.

4. Write down your **translated** tRNA sequence.

5. Write down your amino acid sequence.

6. UV radiation is known to damage DNA. What would happen to your protein if prolonged UV exposure removed the second base in your DNA sequence?

7. What would happen if UV exposure caused a point mutation, where a single base was changed within your DNA sequence?

Building a Protein!

As amino acids reel off of the ribosome after translation, they are in a rather linear form. They then must take on a 3 dimensional shape before they can function. The purpose of this portion of the lab is to demonstrate protein folding in order to make a functional molecule.

There are 20 amino acids in the human body. All have identical backbones that are symbolized by the arrow shaped structure of the model used in this investigation. They differ by functional groups branching from the backbone. There are many different types of functional groups, five of them are represented by numbers on our models.

Using your amino acid sequence from the Transcription & Translation lab as a guide, get the appropriate amino acid structures from around the room. Cut out the structures and assemble them with tape following carefully the rules listed below.

Use the following rules for determing the shape of your protein.

1. Your amino acid sequence will be determined by the order of the DNA code.
2. Proteins always start with an initiation sequence (start), which is the amino acid Methionine. If your sequence does not start with the amino acid Methionine, recheck your transcription/translation from questions 3 & 4.
3 Your protein will start at the left and grow to the right.
4. Like numbers on functional groups bond only with like numbers (1 with 1, 2 with 2, and so on).
5. Functional groups will bond according to the above rules in order of their translation off of the ribosome. For example, if a "2" functional group is found on the first, third, and fifth amino acids, the "2's" only from the first and third amino acids will bond to one another.
6. Odd numbers can bond with two other of the same number, even numbers can bond with only one other "like" number.
7. An amino acid with two fuctional groups may bond with two different amino acids at the same time.
8. "Like" functional groups on a single amino acid will not bond.
9. A functional protein must start with an initiator amino acid (methionine), have a strand of additional amino acids, and end at a STOP, which does not actually code for an Amino Acid.

1. Describe how you determined what your first amino acids was based on the DNA sequence (be specific).

2. Depending upon how your folded your protein, the 3-D structure may vary. Explain how this folding difference may influence the function of the molecule.

3. Assume that the sequence of your amino acids has been altered, say that it was reversed. Given the rules for bonding, would this change the shape of your protein? Give a rationale for your answer.